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Exposures in the City: Looking for Socioeconomic Patterns for the Urban Exposome

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The outdoor urban environment has unique conditions compared with other settings: It is typically louder, with higher levels of air pollution and fewer green spaces, for instance.[1] But urban exposures and associated risks are not spread equally within and between cities, and they may be determined by a family's social or economic position. A recent study in *Environmental Health Perspectives* evaluates how socioeconomic status may affect the urban exposome—the sum total of the exposures experienced in a city's context—among pregnant women in six European countries.[2]

The term "exposome" was coined in 2005 by researcher Christopher Wild, who defined it as the totality of life-course environmental exposures, including lifestyle factors, from the prenatal period on.[3] The exposome concept is relatively new, and several approaches have been proposed to assess it. The concept was intended to stimulate more comprehensive exposure assessment in epidemiological studies and investment in the development of novel exposure assessment tools and approaches. These included "omics" approaches.[4]

Oliver Robinson, lead author of the study and a research fellow with the MRC-PHE Centre for Environment and Health at Imperial College London, sees this paper as showcasing a new framework for urban environmental epidemiology. "We're no longing looking at [exposures] one by one, but we're looking at multiple exposures simultaneously," he says. That allows researchers to investigate the effects of multiple exposures and to improve our understanding of disease etiology. Robinson says many of these outdoor factors are highly correlated—for instance, levels of air pollution are related to the availability of green spaces and traffic density among other factors. So it is important to look at them all together.

This paper emerges from the Human Early Life Exposome (HELIX) project, a five-year collaboration that brought together six population-based birth cohort studies in nine cities across Europe to examine the relationship between the exposome and the health, well-being, and early development of children.[5] It uses a geographic information system approach by taking the coordinates of homes and schools, mining the available municipal data, and using modeling to construct a profile of the exposures people experience. They tracked 28 indicators for nearly 30,000 pregnant women.

With so much data, Lina Mu, director of the Office of Global Health Initiatives at the University at Buffalo School of Public

A new paper illustrates how risk factors and predictors of environmental exposures vary among different countries and cities. For example, the association between lower socioeconomic status and higher air pollution that is reported fairly consistently in the United States is flipped in some European locations, where exposures are higher among wealthier groups. Image: © LeoPatrizi/iStockphoto.

Health and Health Professions, says this paper can help advance the way researchers consider the collective effects of multiple environmental exposures. "We start to talk about the exposome, but really it is not easy to characterize the overall exposure," says Mu, who was not involved in the study. "This paper presents an example of analysis of exposome and health outcomes."

The analysis indicates that exposures vary by city and by neighborhood, but it was difficult to find a consistent pattern. "It was so context specific," Robinson says. "The pattern varied in every way across each country." The authors expected to find results that supported the triple jeopardy hypothesis—that people in poor communities are more exposed to environmental dangers and more prone to getting sick, resulting in health disparities related to environmental factors. In many cities, the results did support that hypothesis. But in others, like Oslo, Norway, the opposite was true for reasons that are not clear.

"There is more context to give," says Denis Sarigiannis, an associate professor of chemical engineering at Greece's Aristotle University of Thessaloniki and coordinator of a different multicountry exposome project, Health and Environment-wide Associations Based on Large Population Surveys (HEALS). He says that an even deeper and more multidisciplinary dive into the different social and economic contexts of each city could be helpful and explain more about why some cities follow the triple jeopardy pattern and others do not. "If you do not put the right context in the analysis of the data, then you end up with conflicting conclusions," Sarigiannis says.

The conclusions were consistent with triple jeopardy in the English city of Bradford, where the data showed that pregnant women of low socioeconomic status were more exposed to air pollution and noise and had less access to greenspace. Study coauthor Rosie McEachan, who directs the Born in Bradford (BiB) birth cohort, says the BiB investigators are applying what they have learned to improve the communities most affected by exposure-related inequalities.

"Because we've been able to really show that clear link between the urban environment and health and well-being, it has enabled us to work with our local authority to try to pull in investment to change things within the city," says McEachan. The BiB team is studying initiatives to retrofit buses and design more greenspace in the areas that need it. It is all a part of the puzzle, she says, of improving the lives of the next generation.

Jori Lewis, writes about the environment, agriculture, and international development from her perch in Dakar, Senegal. She is currently writing a book about the early history of peanuts in West Africa.

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